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Empowering Coffee Farmers in Medalsari Village, Karawang through Environmentally Friendly Coffee Production

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Abstract

The Coffee Farmers Group in Medalsari Village, Karawang Regency, has great potential in robusta coffee cultivation, yet its economic contribution remains limited due to inadequate production facilities, traditional farming techniques, and the absence of product quality standards. This community service program aimed to empower farmers by improving management capacity and applying environmentally friendly and sustainable coffee production techniques. The implementation method included socialization, training, technology adoption, mentoring, evaluation, and program sustainability. Socialization was carried out using participatory approaches, while training combined technology transfer and hands-on practice. Introduced technologies included coffee huller machines, dryers, and roasting machines, as well as the application of organic fertilizers and mulches to reduce dependence on chemical inputs. The results showed a significant increase in farmers' knowledge, with the average pre-test score of 61% rising to 92% in the post-test. Farmers also began implementing soil conservation practices, composting coffee husks, and using disease-resistant varieties. The program effectively improved production quality, strengthened farmer group capacity, and promoted sustainability through collaboration with the university. In conclusion, this program successfully enhanced farmers' knowledge, skills, and adoption of eco-friendly technologies in robusta coffee production, thereby supporting the competitiveness of Karawang coffee in broader markets.

Keywords*: environmentally friendly, farmer empowerment, production technology, coffee, training*

1. INTRODUCTION

Karawang Regency is known as one of the regions in West Java that contributes significantly to the national industrial sector. However, the Karawang community's dependence is not only centered on the industrial sector but also on the agricultural sector (Anggaresti, Abubakar, & Mahatmayana, 2024). In addition to rice, which is the main commodity, one of the agricultural products that has the potential for further development is coffee. Medalsari Village, located in Pangkalan District, Karawang Regency, with an area of 1,471.38 hectares (BPS Karawang, 2025) and a population of around 3,790 (BPS Karawang, 2025), is one of the villages with great potential in the field of coffee plantations. Previous reports BPS Karawang (2025) indicate that coffee production in Karawang reached approximately 207.20 tons, with an average productivity of around 0.50 tons per hectare, demonstrating the emerging role of coffee as a plantation commodity in the region. In Medalsari Village, there is the Purnama Coffee Farmers Group, chaired by Mr. Dimyati, with 17 members who focus on developing the production of robusta coffee as a characteristic of the Karawang area. Despite its great potential in terms of land availability and soil conditions that support coffee growth, the contribution of robusta coffee to increasing farmers' income is still not optimal. This is due to limited production facilities, such as hulling machines, drying machines, and drying houses, so that most of the coffee processing is still done manually with simple equipment. In addition, the cultivation techniques used by farmers are still traditional, with suboptimal fertilization and harvesting techniques that are not uniform among group members. These conditions affect the quality of the harvest, which tends not to meet quality

standards, resulting in a relatively high level of product defects and inconsistent production (Wijaya, Indah, & Fadilla, 2021). The main products currently produced are still limited to ground coffee and dried coffee beans, with minimal variety and no clear quality standards. These limitations are obstacles to improving the competitiveness of Karawang robusta coffee in a wider market.

This community service activity has strong relevance to the Sustainable Development Goals, particularly in supporting responsible consumption and production patterns and addressing climate change. In addition, this community service is also in line with the mission of local resource-based economic development, which emphasizes development from the village as an effort to achieve economic equality, eradicate poverty, and encourage national independence through the development of a green and sustainable economy. This program also supports the policy direction in the National Research Master Plan (RIRN) which focuses on developing the agricultural sector based on innovation and sustainability.

This community service activity aims to improve the quality of robusta coffee production through the application of environmentally friendly cultivation and processing techniques, while also providing training and assistance to the Purnama Coffee Farmers Group on sustainable coffee management and production. In addition, this activity is also aimed at facilitating the application of simple to modern technologies in order to improve the efficiency and quality of coffee products, as well as encouraging the development of product variations and better quality standards. Thus, it is hoped that the Purnama Coffee Farmers Group will be able to increase its capacity in terms of cultivation, processing, and marketing so that Karawang robusta coffee can develop into a leading commodity that provides economic added value for the surrounding community.

2. METHOD

The implementation of this community service program was carried out from August to December 2025 involving 17 members of the Purnama Coffee Farmers Group in Medalsari Village. The activities were conducted in several stages, beginning with socialization, followed by training, technology application, monitoring and evaluation, and program sustainability efforts.

Figure 1. The Stages of Community Service Activities

Socialization

The socialization activity was conducted on 5 August 2025 through presentations, interactive discussions, and the introduction of environmentally friendly coffee production technologies. The community service team delivered materials related to the objectives of the program, the implementation stages, and the importance of adopting environmentally friendly and sustainable coffee management and production practices. This activity took place in the partner's meeting room and was carried out using a participatory approach, allowing group members to actively discuss the challenges they face in coffee cultivation and production. Through this activity, participants gained a better understanding of the benefits and urgency of implementing sustainable agricultural practices.

Training

The training activities were conducted in 6 August, 13 September and 25 October

2025 using a technology transfer approach. The training consisted of theoretical explanations, live demonstrations, and the provision of practical guidelines for environmentally friendly coffee management and production. Participants were trained in several aspects, including sustainable cultivation practices, post-harvest handling, and the operation of the equipment provided through the program. Farmers were also encouraged to directly practice the newly introduced techniques in their coffee production activities to improve their skills and understanding of sustainable coffee farming.

Technology Application

The application of technology was implemented from August to December 2025. During this stage, farmers began applying improved technologies in their coffee production processes. The technologies introduced mainly involved the use of more modern equipment to support coffee management and processing, such as coffee bean hulling machines and coffee drying machines. The use of these technologies aimed to improve the efficiency of post-harvest processing, reduce processing time, and maintain the quality of coffee beans produced by the farmers.

Monitoring and Evaluation

Monitoring and evaluation were carried out in December 2025 to assess the effectiveness of the empowerment program and the level of adoption of environmentally friendly coffee production practices among farmers. The monitoring process observed participants' involvement in program activities, the progress of training outcomes, and the implementation of sustainable cultivation techniques in the field. Data were collected using several methods, including direct observation, structured questionnaires, and interviews with participating farmers. The questionnaires were distributed before and after the training activities to measure changes in farmers' knowledge and understanding of environmentally friendly coffee production practices. In addition, field observations were conducted to evaluate the implementation of the introduced techniques, such as organic fertilization, proper harvesting methods, and post-harvest handling.

The evaluation focused on several indicators, including: (1) the level of farmer participation in training and mentoring activities, (2) improvement in knowledge and skills related to sustainable coffee production, and (3) the adoption of environmentally friendly farming practices. The collected data were analyzed using descriptive statistical analysis to compare the conditions before and after the program implementation. Quantitative data from the questionnaires were summarized using percentages and mean scores to identify changes in farmers' knowledge and attitudes. Meanwhile, qualitative data obtained from interviews and observations were analyzed using descriptive qualitative analysis to provide a deeper understanding of farmers' responses, challenges, and perceptions regarding the implementation of sustainable coffee production practices.

Program Sustainability

Program sustainability will be initiated in January 2026 through follow-up activities based on the evaluation results. These efforts include improvements in coffee management and production practices as well as the integration of community service activities with academic research. The community service team collaborates with the Environmental Engineering, Industrial Engineering, and Chemical Engineering Study Programs at Universitas Singaperbangsa Karawang.Through this collaboration, the Purnama Coffee Farmers Group is expected to become a partner in sustainable research activities that support technological innovation, scientific publications, and the development of an environmentally friendly coffee supply chain. This long term collaboration is intended to strengthen the

sustainability of environmentally friendly coffee production and contribute to the development of local coffee in Medalsari Village.

3. RESULT AND DISCUSSION

Characteristics of the Purnama Coffee Farmers Group

The Purnama Coffee Farmers Group is a group of farmers engaged in coffee cultivation and led by Mr. Dimyati. This coffee farmer group consists of 17 members who strive to develop sustainable coffee production. The main potential of the Purnama Coffee Farmers Group is the availability of sufficient land and soil conditions that support coffee plant growth. The coffee produced is of the robusta variety, which has a more economical selling price than arabica coffee, ranging from Rp. 12,000 to Rp. 100,000 (Suroso & Suherman, 2023), varying depending on the packaging size. This robusta coffee has become a specialty commodity of Karawang Regency. However, its contribution to increasing farmers' income is still not optimal. This is due to the farmers' group's production aspects not being maximized (Anggaresti, Abubakar, & Mahatmayana, 2024). The problem related to the suboptimal production and marketing activities carried out by the Purnama Coffee Farmer Group is caused by limited production facilities. In practice, members of the Purnama Coffee Farmers Group still carry out coffee processing activities such as drying and grinding manually using simple equipment (Figure 2). The inadequacy of supporting facilities such as drying houses and roasting machines is a major challenge in increasing the production of high quality coffee.

Figure 2. Simple coffee production activities

The Coffee Farmers Group obtains coffee raw materials from their own plantations. The coffee plants cultivated are local varieties with distinctive flavors. However, cultivation methods still use traditional methods with suboptimal fertilization and harvesting techniques that vary among group members.

Environmentally Friendly Coffee Production Socialization and Training

The socialization and training were conducted by presenting material on the course of community service activities and presentations related to environmentally friendly and sustainable coffee production in accordance with Good Agricultural Practices (GAP). The socialization and training activities were opened by Selly Arvinda Rakhman, S.Si., M.Sc., as the Master of Ceremony, followed by remarks from the community service team representative, Dr. Kusnadi, S.T., M.T., and remarks from the Head of The Purnama Coffee Farmers Group, Mr. Dimyati. The main material was delivered by Nurul Amri Komarudin, S.Si., M.Si., as the head of the Community Service Team, who provided training on environmentally friendly coffee cultivation techniques (Figure 3).

Figure 3. Socialization and training activities on environmentally friendly coffee cultivation techniques

To measure the absorption of the material, the students facilitated a pre-test and post-test session for the 30 participants (coffee farmers). Based on the pre-test and post-test results presented in Table 1, there was a significant increase in the coffee farmers' knowledge of environmentally friendly and sustainable coffee production practices in accordance with the principles of Good Agricultural Practices (GAP).

Before the activity was carried out, the farmers' knowledge level was relatively low, with an average of 61%. After the socialization and training activities were carried out, the average knowledge increased to 92%. This is in line with the community service carried out by Mundzir & Maulida (2024), which found that socialization and training activities can significantly increase farmers' knowledge. Similarly, in this outreach activity, almost all aspects measured showed improvement, such as understanding of water-efficient irrigation methods, use of fertilizer doses as recommended, utilization of coffee husks as compost, and soil conservation practices. Even in terms of reducing land burning, farmers' understanding increased to 100%.

A significant improvement was also seen in understanding the use of disease-resistant coffee varieties, integrated pest management, and the application of intercropping systems. These results prove that training and outreach activities are effective in increasing farmers' knowledge capacity, while also strengthening their awareness of the importance of environmentally friendly and sustainable coffee cultivation practices (Ariadi, Syarifuddin, & Irfan, 2019).

Table 1. Percentage increase in farmers' knowledge after outreach and training activities

No	Environmentally Friendly Coffee Production Practices	Percentage of Knowledge Level (%)	
		Pre-Test	Post-Test
1	Water-saving irrigation methods are implemented to reduce water waste in coffee plantations.	79	100
2	Using fertilizer doses according to plant needs based on soil tests or technical recommendations.	55	95
3	Processing coffee husk waste into compost or organic fertilizer to reduce environmental pollution.	65	90

No	Environmentally Friendly Coffee Production Practices	Percentage of Knowledge Level (%)	
		Pre-Test	Post-Test
4	Utilizing solar panels as an alternative energy source in post-harvest coffee activities	72	90
5	Planting shade trees to maintain soil moisture, increase biodiversity, and reduce erosion.	56	95
6	Implementing integrated pest management (IPM) to reduce excessive use of chemical pesticides.	56	85
7	Conserving soil through terracing, organic mulching, or ground cover plants in coffee plantations.	60	90
8	Reducing land burning and replacing it with zero burning cultivation practices.	50	100
9	Using disease-resistant or climate-adaptive coffee varieties to reduce the risk of crop failure.	50	85
10	Practicing crop rotation or intercropping with food crops to maintain soil fertility	70	90
	average	61	92

Source: processed primary data (2025)

Application of Environmentally Friendly Coffee Production Technology

The principles of environmentally friendly and sustainable coffee production offered in this empowerment activity apply several technologies and innovations, including the use of organic fertilizers and mulch.

(a) (b)

Figure 4. Microbe-based organic fertilizer (a) and organic mulch from dry leaves

Organic fertilizer is made from the utilization of microbes (Figure 3a), while organic mulch is made from dry leaves or organic waste (Figure 3b). Organic fertilization is carried out to reduce the use of chemical fertilizers, increase soil fertility, improve soil structure, and increase nutrient absorption by plants (Siregar, 2023). while organic mulch is used to cover the soil surface, with one mulch covering approximately 2-4 m^2 of land. The purpose is to maintain soil moisture, reduce erosion, reduce weed growth, maintain soil temperature stability, and increase organic matter content (Rahmawati & Khumairah, 2023).

Modern coffee processing equipment is used to improve the efficiency of the *post*-harvest process and maintain coffee bean quality. The specifications of the equipment used

are a *huller* machine (coffee bean hulling machine) (Figure 5) and a *roasting* machine (Figure 6), each with a capacity of 5 kg/hour for the *huller* machine and 3 kg/cycle for the *roasting* machine.

Figure 5. *Huller* Machine

Figure 6. *Roasting* Machine

Impact of the Program on Coffee Productivity and Quality

The implementation of environmentally friendly coffee production technologies and improved cultivation practices has also shown positive implications for coffee productivity and quality among members of the Purnama Coffee Farmers Group. Prior to the community service activities, coffee production and post-harvest handling were carried out using conventional and manual methods. These practices often resulted in inconsistent bean quality, uneven drying processes, and relatively low efficiency in coffee processing. After the introduction of environmentally friendly cultivation practices and modern processing equipment, farmers began to apply improved management techniques in both cultivation and post-harvest stages. The use of organic fertilizers and organic mulch contributed to better soil fertility, improved soil moisture retention, and enhanced nutrient availability for coffee plants. These improvements are expected to support healthier plant growth and potentially increase coffee productivity in the long term. In addition, the application of soil conservation practices and integrated pest management has helped reduce environmental degradation and maintain the sustainability of coffee plantations.

Significant improvements were also observed in post-harvest coffee processing. The introduction of huller machines and roasting machines enabled farmers to process coffee beans more efficiently and with better quality control. The use of mechanical hulling reduced processing time and minimized physical damage to coffee beans, while controlled roasting helped maintain more consistent flavor characteristics and aroma. As a result, the processed coffee beans produced by the Purnama Coffee Farmers Group showed improved uniformity, cleanliness, and overall quality compared to the conditions prior to the program implementation.

Mentoring and Sustainability Program

During the assistance phase, the community service team provided support starting from the initial socialization process to the coffee production stage. The mentoring activities covered several aspects, including environmentally friendly cultivation techniques, post-harvest handling, and improvements in coffee processing practices. Continuous assistance was also provided through a WhatsApp group that facilitated communication between the partners and the community service team, allowing farmers to discuss challenges encountered during the implementation of the introduced practices.

Evaluation was conducted by measuring program achievements using questionnaires and by observing the progress of coffee farm management and the quality of coffee production. The questionnaire results were analyzed using descriptive analysis to compare farmers' knowledge and practices before and after the mentoring activities. The evaluation results indicate that the Purnama Coffee Farmers Group has begun implementing more environmentally friendly coffee production practices, and the technologies used in the production process are now more efficient compared to the period before the mentoring program.

The analysis of cultivation practices also shows several significant changes after the program implementation. Prior to the activity, coffee cultivation was generally carried out using conventional practices with limited attention to soil fertility management and environmentally friendly inputs. After the mentoring activities, farmers gradually adopted improved cultivation practices, such as the use of organic fertilizers, better pruning techniques to improve plant productivity, and more careful harvesting methods to ensure optimal coffee cherry maturity. In addition, farmers have begun to pay greater attention to post-harvest handling processes, including improved sorting and drying techniques to enhance coffee quality. These changes indicate an increased level of awareness and capacity among farmers in implementing sustainable and environmentally friendly coffee farming practices.

To ensure the sustainability of this program, several steps have been taken by the Community Service Team together with the partners, including the establishment of a comprehensive collaboration between the partners and the Community Service Team, represented by the Environmental Engineering, Industrial Engineering, and Chemical Engineering Study Programs. This collaboration will focus on research activities, where the results will be utilized by lecturers and students for further academic research and development. The Community Service Team will continue to assist the coffee production activities of the Purnama Coffee Farmers Group. In addition, the team and the Purnama Coffee Farmers Group will conduct periodic evaluations of coffee management and production activities every six months. This continuous evaluation is expected to support the long-term sustainability of environmentally friendly and sustainable coffee production in Medalsari Village.

4. CONCLUSION

Community service through the empowerment of environmentally friendly and sustainable coffee farmer groups has had a positive impact on coffee farmers in Medalsari Village, particularly the Purnama Coffee Farmers Group. There has been a significant increase in farmers' knowledge of environmentally friendly and sustainable coffee production practices in accordance with Good Agricultural Practices (GAP) principles. Before the activities were carried out, the farmers' level of knowledge was relatively low, with an average score of 61%. After the socialization and training activities were conducted, the average level of knowledge increased to 92%. This improvement indicates that the mentoring and training programs effectively enhanced farmers' understanding of sustainable coffee production practices. Coffee farmers have begun to utilize environmentally friendly production technologies, such as the application of organic fertilizers and the use of mulch derived from microbial materials and dry leaves. Farmers have also started using modern coffee processing equipment, including coffee bean hullers and roasting machines, to improve the efficiency of post-harvest processing and maintain the quality of coffee beans. The community service team directly provides guidance on the coffee production activities of the Purnama Coffee Farmers Group and conducts periodic evaluations of coffee management and production activities every six months to ensure the sustainability of environmentally friendly coffee production practices.

The implementation of these activities also has important implications for the development of local coffee in Medalsari Village. Improved cultivation and post-harvest practices can contribute to better coffee quality and higher product value, which may strengthen the competitiveness of local coffee in regional markets. Furthermore, the adoption of environmentally friendly farming techniques supports sustainable land management and helps maintain soil fertility in the long term. The empowerment of farmer groups through training and continuous mentoring also strengthens local institutional capacity, enabling farmers to manage coffee production more effectively and collaboratively. In the long term, these improvements are expected to support the development of Medalsari coffee as a potential local commodity, enhance farmers' income, and contribute to sustainable rural economic development in the Karawang region.

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